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ABSTRACT

In this study of the interaction between anxiety trait (A-trait), anxiety state (A-state), and dogmatism in computer-assisted instruction (CAI), subjects were selected on the basis of extreme scores on a measure of anxiety and on a measure of dogmatism. The subjects were presented with a CAI task consisting of difficult mathematical problems. The subject's A-state during the task and number of errors he made on the task were the dependent variables in the study. The hypothesized relationship between dogmatism and A-state was not confirmed. When A-trait was controlled for, subjects did not differ in the level of A-state displayed during the experiment, regardless of their level of dogmatism. As hypothesized, high A-trait subjects had significantly higher levels of A-state during the experiment than low A-trait subjects. Although neither A-trait nor dogmatism was related to errors on the CAI task, a significant interactive effect between mathematics ability and A-state on performance was observed. (JY)

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TECH MEMO

THE EFFECTS OF TRAIT ANXIETY AND DOGMATISM ON STATE ANXIETY DURING COMPUTER-ASSISTED LEARNING

Edward Rappaport

Tech Memo No. 33
May 15, 1971

Project NR 154-280
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The hypothesized relationship between dogmatism and A-State was not confirmed. When controlled for A-Trait, HD and LD S did not differ in the level of A-State displayed during the experiment. As hypothesized, HA-Trait Ss had significantly higher higher levels of A-State during the experiment than LA-Trait Ss.

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The hypothesized relationship between dogmatism and A-State was not confirmed. When controlled for A-Trait, HD and LD Ss did not differ in the level of A-State displayed during the experiment As hypothesized, HA-Trait Ss had significantly higher levels of A-State during the experiment than LA-Trait Ss.

Neither A-Trait nor dogmatism was related to errors on the CAI task. However, a significant interactive effect of math ability and A-State on performance was observed. HA-State resulted in more errors for low math ability Ss but had no effect on the performance of high math ability Ss. This finding was explained in terms of Drive Theory.

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INTRODUCTION

Four years after the publication of The Authoritarian Personality (Adorno, Frenkel-Brunswik, Levinson, & Sanford, 1950), Rokeach (1954) presented his concept of dogmatism as an alternative to the prevailing one of authoritarianism. Rokeach argued that the F Scale developed by Adorno et al. (1950) measures right wing or conservative attitudes, rather than general authoritarianism. Consequently, he developed the Dogmatism Scale (Rokeach, 1956) to measure authoritarianism and intolerance regardless of specific ideology.

Rokeach defined dogmatism as:

> (a) a relatively closed cognitive organization of beliefs and disbeliefs about reality, (b) organized around a central set of beliefs about absolute authority which in turn, (c) provides a framework for patterns of intolerance and qualified tolerance towards others (1954, p. 195).

Rokeach published his major work on dogmatism, The Open and Closed Mind, in 1960. In this book, he presents a theoretical structure for dogmatism that is intimately related to the concept of anxiety. While other aspects of Rokeach's concept of dogmatism and the Dogmatism Scale have been investigated in numerous and diverse studies over the past decade (Vacchiano, Strauss, & Hochman, 1969), his theoretical notions of the relation of dogmatism to anxiety have not been systematically examined.

The present study is concerned with the effects of anxiety and dogmatism in computer-assisted learning. In the following

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sections, the concepts of trait and state anxiety will be presented, Rokeach's theoretical views regarding the relationship between dogmatism and these anxiety concepts will be considered, and the literature on dogmatism and anxiety will be reviewed. Finally, several hypotheses based on Rokeach's view of dogmatism and Spielberger's (1966a; Spielberger, Lushene, & McAdoo, 1971) Trait-State Anxiety Theory will be set forth.

Trait-State Anxiety Theory

Theory and research on anxiety have suffered from the failure to distinguish between state anxiety (A-State) and trait anxiety (A-Trait). According to Spielberger:

> Anxiety states (A-states) are characterized by subjective, consciously perceived feelings of apprehension and tension, accompanied by or associated with activation or arousal of the autonomic nervous system. Anxiety as a personality trait (A-trait) would seem to imply a motive or acquired behavioral disposition that predisposes an individual to perceive a wide range of objectively nondangerous circumstances as threatening, and to respond to these with A-state reactions disproportionate in intensity to the magnitude of the objective danger (1966a, pp. 16-17).

In most research on anxiety, measures are used which tap anxiety proneness (A-Trait) rather than the intensity of anxiety feelings at a given moment (A-State). Other studies have used physiological measures such as blood pressure and the galvanic skin response to investigate A-State. Self-report measures of state anxiety have also been recently developed (e.g., Zuckerman, 1960) and one of these, the State-Trait Anxiety Inventory (STAI) (Spielberger, Gorsuch, & Lushene, 1970) was

used in this study. The STAI provides self-report measures of both A-Trait and A-State.

Rokeach's Concept of Dogmatism in Relation to Anxiety

Rokeach and Restle (1960) write that the closed minded or high dogmatic individual believes "the world one lives in or the situation one is in at a particular moment is a threatening one (p. 56)." They further suggest that the closed mind represents a network of defenses which serves to allay or reduce the anxiety (A-State) of high dogmatic individuals. Rokeach and Restle state:

> The more closed the belief-disbelief system, the more do we conceive it to represent in its totality, a tightly woven network of cognitive defenses against anxiety. Such psychoanalytic defense mechanisms as repression, rationalization, denial, projection, reaction formation and overidentification may all be seen to have their representation in the belief-disbelief system in the form of some belief or in the form of some structural relation among beliefs. Indeed, we suggest that, in the extreme, the closed system is nothing more than the total network of psychoanalytic defense mechanisms organized together to form a cognitive system and designed to shield a vulnerable mind (pp. 69-70).

Rokeach's position on the relationship between dogmatism and anxiety is both ambiguous and vague. On the one hand, he infers that high dogmatic individuals should be more anxious since they view the world and particular situations as more threatening. On the other hand, he claims that the closed mind reduces anxiety. Since high dogmatics tend to be high in

A-Trait, it follows from Trait-State Anxiety Theory that they will respond to stress with greater increments in A-State than low dogmatics. This is consistent with Rokeach's position that high dogmatics are more anxious than low dogmatics. Therefore, if one is to study the effects of dogmatic defenses on state anxiety, A-Trait must be controlled.

The apparent discrepancy in Rokeach's formulations can be reconciled in terms of Spielberger's Trait-State Anxiety Theory by considering the process through which dogmatic defenses serve to reduce anxiety. It is possible that high dogmatic persons are more anxious than low dogmatic individuals because they initially respond to stress situations with greater increments in A-State. As the defense mechanisms of the high dogmatic individual become more effective, he may subsequently show a greater decrease in A-State than low dogmatic individuals. The literature on dogmatism and anxiety will be examined to evaluate the plausability of this formulation.

Studies on Dogmatism and Anxiety

The studies relevant to the relationship between anxiety and dogmatism may be divided into two types: (1) studies which relate scores on the Dogmatism Scale to various anxiety measures; and (2) studies which provide evidence that dogmatism serves as a defense against anxiety.

The Relation Between Dogmatism and Anxiety

Rokeach and Kemp (1960) hypothesized that since the

closed mind is a defense against anxiety, dogmatic individuals should manifest more anxiety than open minded individuals. In support of this hypothesis the authors present correlations obtained between an adapted version of the Welsh Anxiety Scale (a measure of A-Trait and Rokeach's Dogmatism Scale. For seven samples of subjects the product moment correlations were all positive and significant ($p < .01$), ranging from .36 for English factory workers to .64 for a sample of Michigan State University undergraduates. A number of other investigators have also reported positive and significant correlations between dogmatism and anxiety (Fillenbaum & Jackman, 1961; Norman, 1966; Pyron, 1966; Rebhun, 1966).

Further support for the positive relationship between trait anxiety and dogmatism is provided in two factor analytic studies (Fruchter, Rokeach, & Novak, 1958; Rokeach & Fruchter, 1956). In both studies, dogmatism and anxiety (as measured by the Welsh Scale) emerge together as part of a single psychological factor. Similarly, in a factor analysis performed by Pyron (1966) involving a number of attitude scales, the Dogmatism Scale and the Taylor Manifest Anxiety Scale were found to load on the same factor which was labeled "Rejection-Acceptance of attitude positions and social stimuli tending to threaten or change the perceptual ordering and belief systems."

There are two studies which deal with state anxiety and its relation to dogmatism. Rokeach and Bonier (1960) report

that high dogmatic subjects, while responding to the Thematic Apperception Test (TAT), expressed more state anxiety[1] and used the future tense in their stories significantly more than did open minded subjects. The authors interpreted these findings as providing evidence for their hypothesis that closed minded individuals employ a future-oriented time perspective which can be viewed as a defense against anxiety. Snoek and Dobbs (1967) found that high dogmatic subjects manifested larger galvanic skin responses while listening to statements with which they were in strong agreement or disagreement. The authors conclude: "Since the dogmatic individual, according to the theory, is generally more anxious, it seems reasonable to suppose that he cares more whether other people agree or disagree with him (p. 198)." Unfortunately, neither Rokeach and Bonier nor Snoek and Dobbs controlled for trait anxiety in their studies. Hence, the greater A-State experienced by high dogmatics, may have simply reflected higher A-Trait rather than closed mindedness.

The studies presented thus far suggest that high scorers on the Dogmatism Scale are higher in A-Trait than low scorers. Rokeach and his associates (1960) feel that such findings

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[1] While the authors do not use the concept of A-State, their measures included the subjects' behavioral expressions of anxiety while telling the story (excessive hesitation, voice tremor, coughing, etc.) and ratings of the amount of anxiety and threat exhibited in the stories.

support the theoretical position that the closed mind of the dogmatic individual represents a cognitive network of defenses against anxiety. It has not been clearly demonstrated, however that the closed mind serves to allay A-State. While the positive correlations between trait anxiety and dogmatism suggest, as Rokeach claims, that high dogmatic individuals perceive the world as more threatening, the question remains whether high dogmatic individuals can defend against state anxiety more efficiently than low dogmatics when A-Trait is controlled.

Dogmatism as a Defense Against Anxiety

Studies of the closed mind as a defense against anxiety typically do not include measures of either A-Trait or A-State. For example, Long and Ziller (1965) found significant negative correlations between the Dogmatism Scale and four measures of tendencies to reserve judgment: low dogmatic subjects tended to delay decisions. The investigators concluded that: "The dogmatic individual defends an insecure self structure by the expedient of restricting information input - that is, by controlling the source of data relevant to his self and social conceptual structures (p. 378)."

Tosi, Fagan, and Frumkin (1968) found that high dogmatic subjects in a group personality-testing situation, when given the choice of identifying themselves by name or more anonymously by birthdate, would more often choose the latter

means of identification relative to low dogmatic subjects. Apparently, the high dogmatic subjects perceived the testing situation as threatening and defended against their anxiety by not disclosing thier identity.

LoScuito and Hartley (1963) reported that high dogmatic subjects were less alert to religious symbols, words, and pictures from "other religions" in a stereoscopic task. These findings may be interpreted as indicating that the high dogmatic subjects defended their belief systems by repressing the material representing "other religions." Byrne, Blaylock, and Goldberg (1966) and Bernhardson (1967), utilizing the Repression - Sensitization Scale, found that dogmatism was associated with sensitizing rather than repressive defenses. However, this finding does not rule out the possibility that closed minded subjects, as suggested by the above studies, also utilize repressive defenses.

While none of these studies integrate the theoretical notions of the relationship between dogmatism and anxiety as stated by Rokeach, a study by Hallenbeck and Lundstedt (1966) provides some support for the formulations set forth earlier concerning dogmatic defenses. They found that blind high dogmatic subjects tended to deny their disability relative to the blind low dogmatic subjects, while low dogmatic subjects experienced significantly greater depression. This finding supports the notion that high dogmatic individuals are more

defensive than low dogmatics. However, when these results were analyzed in terms of whether the onset of blindness was sudden or gradual, only with a gradual onset was dogmatism significantly correlated with denial, which would be expected according to the formulations set forth earlier. In the gradual onset of blindness, the defenses had sufficient time to be activated, whereas in sudden onset, the defenses were apparently not effective.

A more direct test of the formulations concerning dogmatic defenses is provided by the pilot study which is described below.

Pilot Study

The effect of anxiety on computer-assisted instruction (CAI) was investigated by James and O'Neil (1969) for female subjects who were selected on the basis of extreme scores on the STAI A-Trait scale. Difficult mathematical learning materials were presented by an IBM 1500 CAI system which also presented brief 5-item, STAI A-State scales during the task. The writer, having administered the Dogmatism Scale to these subjects prior to the experiment, divided them into two groups: high dogmatism and low dogmatism. The two groups were controlled for A-Trait since they each consisted of an equal number of high A-Trait and low A-Trait subjects. The results are plotted in Figure 1. High dogmatic subjects responded initially to

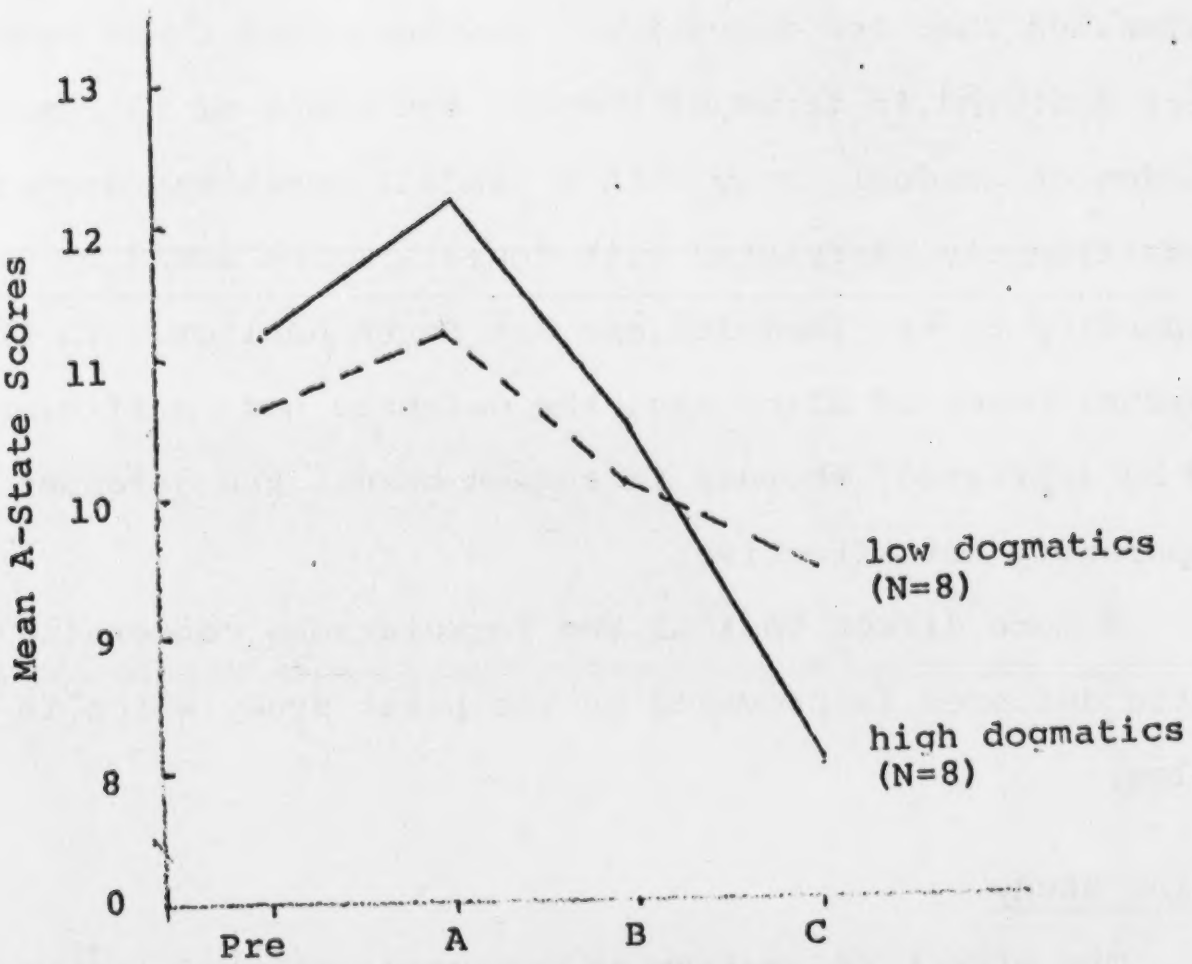

Fig. 1.--Mean A-State scores for high and low dogmatic subjects in the pretask period and the three sections of the CAI task (pilot study)

the task with larger increments in A-State than the low dogmatic subjects. However, by the end of the task, high dogmatic subjects exhibited lower levels of A-State than low dogmatic subjects. Hence, high dogmatic subjects responded initially to the situation with larger rises in A-State than low dogmatic subjects. But towards the end of the task, the dogmatic defenses had apparently become effective and the high dogmatic subjects displayed less A-State than the low dogmatic subjects.

Statement of the Problem

The purpose of this study is to investigate changes in A-State during computer assisted instruction in Ss who differ in A-Trait and dogmatism. The Ss were selected on the basis of extreme scores on the STAI A-Trait scale and the Dogmatism Scale. The CAI task consisted of difficult mathematical problems. A-State and errors during the task were the dependent variables. Based on Rokeach's theory of dogmatism and Spielberger's Trait-State Anxiety theory, the following hypotheses were tested in this study:

1. When controlled for A-Trait, high dogmatic Ss were expected to display higher levels of A-State than low dogmatic Ss during the initial part of the learning task since according to Rokeach, closed minded individuals perceive the world as more threatening.
2. When controlled for A-Trait, high dogmatic Ss would exhibit lower levels of A-State than low dogmatic Ss during the final part of the learning task. This hypothesis follows from Rokeach's position that the defenses of the dogmatic individual serve to allay anxiety.
3. High A-Trait Ss were expected to display higher levels of A-State than low A-Trait Ss throughout the experiment. According to Spielberger's Trait-State Anxiety theory, high A-Trait Ss should experience greater elevations in A-State relative to low A-Trait Ss.

METHOD AND PROCEDURE

Subjects

The STAI and the Dogmatism Scale were administered in a group testing session to 198 females enrolled in the introductory psychology course at Florida State University. Students with STAI A-Trait scores which fell in the upper quartile of the STAI norms for undergraduate females (see Spielberger et al., 1970, Table 2, p. 11) were designated as high A-Trait (HA-Trait), while those whose scores fell in the lower quartile were designated as low A-Trait (LA-Trait).

The cut off scores for the HA-Trait and LA-Trait Ss were above 41 and below 33, respectively. Subjects with scores in the upper third on the Dogmatism Scale were designated as high dogmatism (HD), while those with scores falling in the lower third of the distribution for this scale were designated as low dogmatism (LD). The cut off scores for the HD and LD Ss were above 144 and below 131, respectively.

Subjects with extreme scores on both the STAI and the Dogmatism Scale were selected to participate in the CAI task. The E contacted each S both by letter and by telephone. The experimental design required 15 Ss in each of the four experimental groups. However, to guard against the possible loss of data in the CAI system, an additional 20 Ss were asked to participate in the CAI task. After the experiment was completed it was determined that no data was lost in the CAI system. Thus, in order to have 15 Ss in each group, it was necessary to eliminate 13

LA-Trait/LD Ss, 6 HA-Trait/HD Ss and 1 HA-Trait/LD S. These Ss were eliminated in a manner such that the A-Trait and Dogmatism scores were appropriately matched in the experimental groups. The means and standard deviations of the STAI A-Trait and Dogmatism scores for the four experimental groups are presented in Table 1.

TABLE 1.--Mean STAI A-Trait and dogmatism scores for the four experimental groups

Groups	A-Trait	Dogmatism
LA-Trait/LD		
Mean	26.8	117.1
SD	3.3	11.4
LA-Trait/HD		
Mean	27.3	157.3
SD	3.1	7.9
HA-Trait/LD		
Mean	46.5	117.5
SD	4.9	12.3
HA-Trait/HD		
Mean	48.6	159.5
SD	4.1	7.1

(N=15 for each group)

Experimental Measures

The experimental measures employed in this study consisted of instruments designed to assess A-Trait, A-State and dogmatism.

The State-Trait Anxiety Inventory (STAI) - The STAI (Spielberger, et al., 1970) was used to measure both A-Trait and A-State. (A copy of the STAI may be found in Appendix A.) The STAI A-Trait scale consists of 20 statements that ask people to describe how they generally feel (e.g., "I feel like crying;" "I am content"). The A-State scale similarly consists of 20 items, however, the instructions require Ss to indicate how they feel at a given moment in time (e.g., "I feel upset;" "I am relaxed").

In addition, a short form of the A-State Scale employed by O'Neil (1969), consisting of the five items with the highest item-remainder correlations in the STAI normative sample was utilized to measure A-State during the learning task. (Appendix B contains a list of these five items.)

The Dogmatism Scale - Rokeach's Dogmatism Scale (1956) consists of 40 statements to which Ss respond on a seven point agree - disagree format (e.g., "Man on his own is a helpless and miserable creature;" "My blood boils whenever a person refuses to admit he is wrong"). (The Dogmatism Scale may be found in Appendix C.) The Dogmatism Scale measures general authoritarianism and intolerance regardless of specific ideology.

Learning Materials

The CAI task consists of difficult mathematical learning materials, relating to proofs of the field properties of complex numbers. These materials are adapted from the CAI task used by O'Neil, Hansen and Spielberger (1969). The task is

divided into three sections, labeled A, B and C, consisting of five problems per section. The Ss are required to solve each successive problem correctly before they can proceed to the next one.

Apparatus

An IBM 1500 Computer Assisted Instruction System (IBM, 1967) was used to present the learning materials. The terminals for this system consist of a cathode-ray tube (CRT), a light pen and a keyboard. The terminals were located in an air conditioned, sound-deadened room. The CAI system also administered the STAI A-State Scales and recorded the Ss' responses and response latencies.

Experimental Procedure

The experimental procedure is basically the same as that employed by O'Neil (1969). Upon arriving at the CAI Center, the Ss were seated at CAI terminals. Each S was given an introductory booklet (O'Neil, 1969), (see Appendix D) which contained the following instructions:

> It has been found that success in this program does not require mathematical or quantitative ability; it requires instead, the ability to make the same kind of observations and generalizations that you are expected to make in many college courses.

The Ss were asked to read a description of the operation of the CAI terminal, given practice in the operation of the light pen and keyboard, and instructed in the erase and enter functions. The E answered questions and demonstrated the

procedures. After "signing on", all Ss responded to the 20 item STAI A-State scale which was presented on the CRT.

During the task all the Ss worked through the same learning materials, each progressing at her own speed. Immediately after each of the three sections of the learning task, the short form of the STAI A-State scale was given with the instructions to "indicate how you felt during the section of the task you have just finished."

After each S completed the learning task she was administered the Posttask Questionnaire, (see Appendix F) which inquired about her reactions to the task and about her mathematical ability. After completing the Posttask Questionnaire, each S was debriefed. At this time she was given additional information concerning the general nature of the experiment and cautioned not to discuss the study with her classmates.

RESULTS

The results are divided into four major sections. In the first seqtion, changes in A-State scores were examined as a function of A-Trait and dogmatism. Next, errors on the CAI task as a function of A-Trait and dogmatism were analysed. In the third section, the relationship between A-State and errors was considered. Finally, errors as a function of A-State and math ability were investigated.

Effect of A-Trait and Dogmatism on Changes in A-State

The 20-item STAI A-State scale was given before the beginning of the CAI task, and the 5-item short form of the scale was given immediately after each of the three sections of the task. All of the statistical analyses of the A-State data are based on the short form of the STAI A-State scale. For the pretask measure, the five-items comprising the short form were extracted from the total A-State scale.

The means and standard deviations of the STAI A-State scores for the four experimental groups are reported in Table 2 for the pretask period and the three sections of the CAI task. These data were evaluated by a three way analysis of variance (ANOVA) in which A-Trait, dogmatism and periods were the independent variables, with repeated measures on the last factor. The results of this ANOVA are presented in Table 3, in which it may be noted that only the main effects of

TABLE 2.--The mean 5-item A-State scores for the four experimental groups in the pretask period and in the three sections of the CAI task

Group	Pretask	Section A	Section B	Section C
LA-Trait/LD				
Mean	7.9	10.9	9.6	10.8
SD	1.9	2.8	2.4	2.8
LA-Trait/HD				
Mean	7.7	10.8	9.9	10.3
SD	2.4	2.7	2.7	2.8
HA-Trait/LD				
Mean	9.3	11.9	10.6	10.3
SD	3.6	3.8	3.1	3.0
HA-Trait/HD				
Mean	9.1	12.2	12.6	12.5
SD	2.5	2.9	3.5	3.9
All groups				
Mean	8.5	11.5	10.7	11.0
SD	2.7	3.0	3.1	3.2

(N=15 for each group)

TABLE 3.--Summary of the overall analysis of variance of the A-State scores for the four experimental groups

Source	df	MS	F
A-Trait (A)	1	104.0	5.25*
Dogmatism (D)	1	13.1	<1
A x D	1	22.8	1.15
Error (b)	56	19.8	
Periods (P)	3	102.3	20.05**
A x P	3	2.5	<1
D x P	3	6.6	1.29
A x D x P	3	5.9	1.16
Error (w)	168	5.1	

*p<.05
**p<.01

A-Trait and periods were statistically significant. The hypothesized dogmatism by periods interaction did not materialize. Furthermore, the absence of a significant main effect of dogmatism points out that HD Ss did not differ significantly from LD Ss with respect to A-State scores.

Figure 2 illustrates that HA-Trait Ss displayed higher levels of A-State than LA-Trait Ss throughout the experiment as hypothesized. It should be noted that the absence of a significant A-Trait by periods interaction suggests that HA- and LA-Trait Ss exhibited parallel changes in A-State during the experiment.

In order to further examine the periods main effect, two additional ANOVAs were performed on the A-State data. The first ANOVA, which evaluated initial reactions to the CAI task, was based on the A-State measures for the pretask period and Section A of the task. The second ANOVA, which evaluated reactions during the task, was based on the A-State measures for Sections A, B, and C.

Table 4 presents the results of the ANOVA for the A-State scores in the pretask period and in Section A. The significant periods main effect indicates that A-State rose significantly from the pretask period to Section A of the CAI task. The significant main effect of A-Trait reveals that HA-Trait Ss had higher A-State scores than the LA-Trait Ss in the pretask period and during Section A.

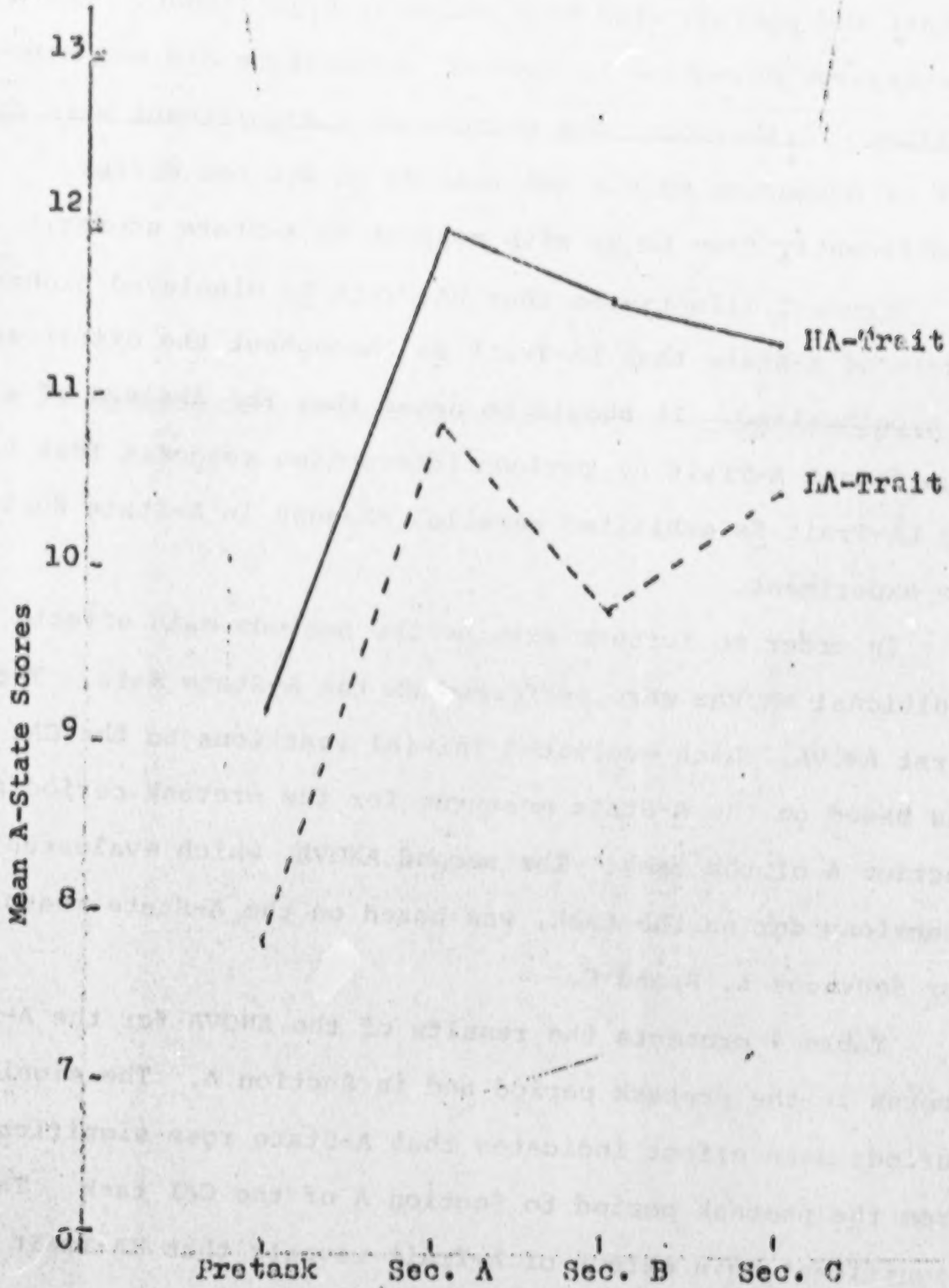

Fig. 2.--Mean A-State scores for HA- and LA-Trait Ss in the pretask period and the three sections of the CAI task.

TABLE 4.--Summary of analyses of variance of A-State scores for the four experimental groups in the pretask period and Section A, and in Sections A, B, and C

Source	Pretask & Section A df	MS	F	Sections A, B & C df	MS	F
A-Trait (A)	1	49.4	5.68*	1	74.8	3.38
Dogmatism (D)	1	.2	<1	1	22.8	1.03
A x D	1	.4	<1	1	30.4	1.38
Error (b)	56	8.7		56	22.1	
Periods (P)	1	261.1	33.91**	2	9.0	3.00
A x P	1	.4	<1	2	3.7	1.23
D x P	1	1.0	<1	2	4.5	1.50
A x D x P	1	.4	<1	2	5.1	1.70
Error (w)	56	7.7		112	3.0	

* $p < .05$
** $p < .01$

The results of the ANOVA for the A-State scores obtained for Sections A, B and C of the CAI task are also presented in Table 4. In this analysis none of the main effects or interactions were significant. As can be seen in Figure 2, there was a tendency for A-State scores to drop from Section A to Section B, but this trend did not yield a significant main effect of periods ($p < .01$) because of the marked variability in A-State scores. Also, as may be seen in Figure 2, the HA-Trait Ss continued to respond with higher levels of A-State than LA-Trait Ss during the CAI task to about the same extent as they had during the pretask period. However, the increased variability in A-State scores while the Ss worked on the task resulted in an A-Trait main effect that was significant only at the .10 level. The high variability in A-State during the CAI task is apparent in the standard deviations in Table 2, especially for the HA-Trait/HD Ss.

Errors as a Function of A-Trait and Dogmatism

The means and standard deviations for the errors made by the experimental groups for each section of the CAI task are presented in Table 5. These data were evaluated by a three way ANOVA in which A-Trait, dogmatism and periods were the independent variables, with repeated measures on the last factor. The number of errors per problem for each section of the CAI task was the dependent variable. The results of this ANOVA are reported in Table 6, in which the only significant result was the main effect of periods. This finding reflected the fact that the number of errors decreased sharply from Section A to Section B of the CAI task. There was little change in the number of errors from Section B to Section C. The absence of any statistically significant findings involving A-Trait or dogmatism, indicates that errors during the CAI task were not systematically influenced by these variables.

The finding in this study that level of A-Trait was not related to errors on the CAI task is consistent with the results of Spielberger, O'Neil, and Hansen (1971). These investigators, utilizing the same CAI task as the present study, found in two separate studies that only on Section A did HA-State Ss make significantly more errors than LA-State Ss. Therefore, the relation between errors and A-State in the present study is examined in the next section.

TABLE 5.--The mean number of errors for the four experimental groups in Sections A, B and C of the CAI task

Groups	Section A	Section B	Section C
LA-Trait/LD			
Mean	5.0	2.8	3.6
SD	2.5	3.5	4.4
LA-Trait/HD			
Mean	5.0	2.7	2.8
SD	3.4	1.7	2.9
HA-Trait/LD			
Mean	4.0	2.3	2.2
SD	4.1	3.0	3.3
HA-Trait/HD			
Mean	6.3	3.7	2.5
SD	5.0	4.0	2.1
All groups			
Mean	5.1	2.8	2.8
SD	3.8	3.2	3.3

(N=15 for each group)

TABLE 6.--Summary of analysis of variance of errors for the four experimental groups in Sections A, B and C

Source	df	MS	F
A-Trait (A)	1	.4	<1
Dogmatism (D)	1	9.0	<1
A x D	1	37.9	1 47
Error (b)	56	25.7	
Periods (P)	2	104.7	20.53**
A x P	2	6.8	1.33
D x P	2	7.1	1.39
A x D x P	2	1.3	<1
Error (w)	112	5.1	

*p<.05
**p<.01

Effect of Level of A-State on Errors

In evaluating the effect of A-State on errors, the brief (5-item) A-State scores for each S on the three sections of the CAI task were added together to provide a more stable measure of A-State. As previously noted, it was found that A-State did not fluctuate significantly during the CAI task, which provides justification for combining the brief A-State measures. The distribution of the summed A-State scores, which ranged from 15 to 57, was divided at the median: Ss whose A-State scores were above the median (33 and above) were designated as the high A-State group (HA-State); those whose A-State scores fell below the median (32 and below) were designated as the low A-State group (LA-State).

The mean number of errors per problem for HA-State and LA-State Ss on each section of the CAI task is presented in Table 7. These data were evaluated by a two way ANOVA in which level of A-State and periods were the independent variables, with repeated measures on the last variable. The results of this ANOVA are reported in Table 8. Only the main effect of periods was significant, which indicates that the number of errors decreased from Section A to Section B of the CAI task. Consistent with the findings of Spielberger, O'Neil, and Hansen (1971), HA-State Ss tended to make more errors on Section A of the CAI task than LA-State Ss, and both groups made almost the same amount of errors during Sections B and C. However, in the present study, the A-State by periods interaction failed

TABLE 7.--The mean errors for HA- and LA-State Ss in Sections A, B, and C of the CAI task

Groups	Section A	Section B	Section C
HA-State			
Mean	5.9	2.8	3.1
SD	4.6	3.5	3.1
LA-State			
Mean	4.2	2.8	2.5
SD	2.7	2.8	3.4

(N = 30 for each group)

TABLE 8.--Summary of analysis of variance of errors for HA- and LA-State Ss in Sections A, B, and C of the CAI task

Source	df	MS	F
A-State (A)	1	26.5	1.05
Error (b)	58	25.2	
Periods (P)	2	104.7	20.94**
A x P	2	11.3	2.26
Error (w)	116	5.0	

*p<.05
**p<.01

to reach statistical significance ($p < .15$) As with the A-State scores, there was large variability in the number of errors, which is reflected in the standard deviations in Table 7.

Errors as a Function of A-State and Math Ability

Math ability appeared to be a major determinant of performance on the CAI task. Correlations of self ratings of math ability with errors were -.40 ($p < .01$), -.50 ($p < .01$) and -.42 ($p < .01$) for Sections A, B and C, respectively. The higher the Ss rated themselves in math ability, the fewer errors they made on each section of the CAI task. Thus, math ability as a determinant of performance on the task contributed to the variability within experimental groups since each group was heterogeneous with regard to math ability.

It has been demonstrated that ability and anxiety may have an interactive effect on performance on learning tasks (e.g., Denny, 1963; Spielberger, 1966b; Gaudry & Spielberger, 1970). In general, HA-State tends to increase errors for low ability Ss, but either results in fewer errors or has no effect on the performance of high ability Ss. In the light of these findings, the relationship between A-State and errors was evaluated in the present study, taking into consideration the Ss' math ability.

One item on the Posttask Questionnaire asked the Ss to rate themselves in math ability on the following three point scale: (1) Below Average; (2) Average; (3) Above Average.

Of the 60 Ss, 20 Ss rated themselves as below average, 25 rated themselves average and 15 Ss rated themselves above average. The Ss who rated themselves above and below average were designated as the high math ability (HMA) and low math ability (LMA) groups. In the analysis of the relationship between A-State, math ability and errors, Ss who rated themselves as average in math ability were not included since it was necessary that the groups be well differentiated because of the crudeness of the math ability measure.

As in the previous analysis, the distribution of summed A-State scores for HMA and LMA Ss, which ranged from 21 to 57, was divided at the median: Ss whose scores were above the median (33 and above) were designated as the HA-State group; those with A-State scores below the median (32 and below) were designated the LA-State group. In order to utilize a repeated measures computer program, it was necessary to randomly eliminate six LMA Ss and one HMA S, thereby providing an equal number (N=7) in each of the four experimental groups: LA-State/LMA Ss, LA-State/HMA Ss, HA-State/LMA Ss, and HA-State/HMA Ss.

The mean number of errors per problem in each section of the CAI task for the four experimental groups is presented in Table 9. These data were evaluated by a three way ANOVA in which A-State, math ability and periods were the independent variables, with repeated measures on the last factor. The results of this ANOVA, which are reported in Table 10, indicate

TABLE 9.--The mean errors in Sections A, B, and C of the CAI task as a function of A-State and math ability

Groups	Section A	Section B	Section C	Total
HA-State/HMA				
Mean	3.1	.7	.8	1.5
SD	2.7	.9	1.2	1.6
HA-State/LMA				
Mean	7.8	6.5	6.5	6.9
SD	4.2	5.4	4.7	4.8
LA-State/HMA				
Mean	3.7	1.1	.7	1.8
SD	2.0	1.2	.5	1.2
LA-State/LMA				
Mean	4.7	3.2	2.2	3.4
SD	2.3	2.4	2.8	2.5

(N=7 for each group)

TABLE 10.--Summary of analysis of variance of errors in Sections A, B and C as a function of A-State and math ability

Source	df	MS	F
A-State (A)	1	54.7	4.60*
Math Ability (M)	1	253.1	21.27**
A x M	1	78.1	6.56*
Error (b)	24	11.9	
Periods	2	42.3	6.13**
A x P	2	1.9	<1
M x P	2	2.2	<1
A x M x P	2	.1	<1
Error (w)	48	6.9	

* $p<.05$
** $p<.01$

a significant interaction between A-State and math ability, as well as significant main effects for A-State, math ability, and periods.

The A-State by math ability interaction is depicted in Figure 3 in which it may be noted that the HA-State Ss with LMA made more errors than the LA-State/LMA Ss, whereas there was no difference between the HA-State/HMA and LA-State/LMA Ss. The main effects for A-State and math ability must be interpreted within the context of this interaction, and the periods main effect indicates that the Ss made more errors in Section A of the CAI task than in Sections B and C.

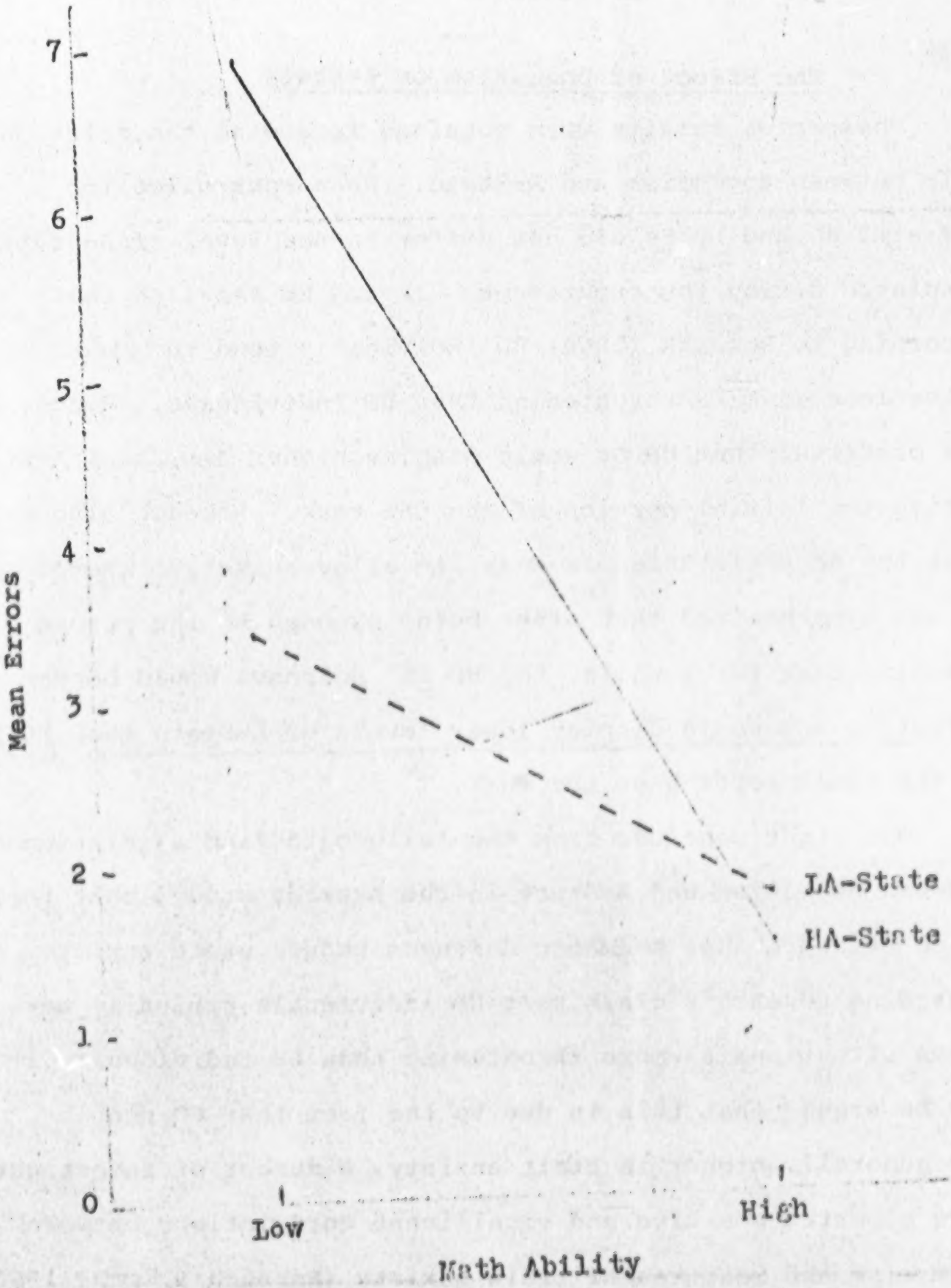

Fig. 3.--Mean errors as a function of A-State and math ability

DISCUSSION

The Effect of Dogmatism on A-State

Unexpected results were obtained regarding the relationship between dogmatism and A-State. When controlled for A-Trait, HD and LD Ss did not differ in the level of A-State displayed during the experiment. It may be recalled that according to Rokeach (1960) HD individuals tend to view situations as more threatening than LD individuals. Hence, it was predicted that HD Ss would display higher levels of A-State during the initial portion of the CAI task. Rokeach also writes that the dogmatic defenses serve to allay anxiety. Therefore, it was hypothesized that after being exposed to the stressful learning task for a while, the HD Ss' defenses would become effective and would display lower levels of A-State than LD Ss by the final portion of the task.

One might conclude from the failure to find a relationship between dogmatism and A-State in the present study, that there is no evidence that dogmatic defenses reduce state anxiety. Regarding Rokeach's claim that HD individuals typically perceive situations as more threatening than LD individuals, it may be argued that this is due to the fact that HD people are generally higher in trait anxiety. A number of investigators have reported positive and significant correlations between dogmatism and measures of trait anxiety (Rokeach & Kemp, 1960;

Fillenbaum & Jackman, 1961; Norman, 1966; Pyron, 1966; Rebhun, 1966). In the present study a correlation of .26 ($p < .01$) was obtained between dogmatism and A-Trait. In other words, whether or not a person displays a high level of A-State in a situation depends not on his level of dogmatism, but rather on his A-Trait level. By virtue of the fact that HD individuals tend to be higher in A-Trait than LD individuals, high dogmatics will more frequently perceive situations as threatening and respond with higher levels of A-State than low dogmatics. But dogmatism by itself has no effect on A-State. However, before coming to any conclusions regarding the relationship between dogmatism and A-State, a number of factors must be considered.

There are several factors which may have biased the results of the present study. It appeared that the E had developed strong rapport with the Ss. The E was present during the initial group testing as well as during the CAI task. Each S selected for the CAI experiment received a letter from the E saying that she was chosen for the second session of the study. Also, the E personally telephoned each S at least once to schedule the session at the CAI Center. Hence, the HD Ss' tendency to view the situation as threatening may have been overcome through the friendly rapport developed by the experimenter. Furthermore the Ss participated in the CAI task in groups of twelve. There were subtle communications of frustration, e.g., sighs, during the task which may have created a

feeling of group cohesion thereby reducing the perceived personal threat of the task.

An artifact of the group testing session may have had unknown effects on the Ss' performance during the CAI task. As part of the group testing session the students took part in an experiment involving a stressful exam not connected with the present study. Since the E was present during this stressful exam, some Ss may have erroneously concluded that they were selected on the basis of their performance on the exam. Several Ss communicated such a belief to the E.

A more basic factor to consider is the appropriateness of utilizing the CAI task to study the operation of dogmatic defenses. Rokeach (1960) writes that the closed mind of the dogmatic individual serves to protect his belief-disbelief system. The difficult CAI task may pose a threat to some of the Ss' beliefs about themselves as college students, beliefs about their intellectual capacity, etc. However, in the present study such beliefs were not systematically investigated. Before any conclusions can be reached concerning the relationship between dogmatism and A-State, additional research is required on HD and LD Ss, controlled for A-Trait, in which A-State is measured while their beliefs are systematically threatened.

Furthermore, future research on the relationship between dogmatism and anxiety should consider that dogmatism, like anxiety, may be conceptualized in terms of trait and state. Rokeach, Toch and Rottman (1960) write:

> We think of a person's belief system as possessing not only enduring properties, but also the property of expanding and contracting, of becoming more open, or more closed, in response to a specific situation in which the person finds himself. We assume that the more threatening a situation is to a person, the more closed his belief system will tend to become (p. 376).

Thus, a LD S, who is generally not prone to use dogmatic defenses, may nevertheless employ dogmatic defenses if he perceives threat.

The Effect of A-Trait on A-State

The HA-Trait Ss displayed significantly higher levels of A-State than LA-Trait Ss during the experiment as hypothesized. This finding is consistent with previous CAI research (Spielberger, O'Neil, & Hansen, 1971) and provides support for Spielberger's Trait-State Anxiety Theory. According to the Trait-State Anxiety Theory, HA-Trait Ss are more prone to experience greater elevations in A-State than LA-Trait Ss.

During the CAI task the HA-Trait Ss continued to respond with higher levels of A-State than LA-Trait Ss to about the same extent as they had during the pretask period. But, the increased variability in A-State scores while the Ss worked on the task prevented this trend from reaching statistical significance. Math ability, a factor which may have contributed to this increased variability in A-State scores during the task, is discussed in the next section. However, in accounting for this failure to reach

statistical significance, it should be noted that the HA-Trait Ss in the present study had significantly more math courses than LA-Trait Ss (see Appendix F). To the extent that the number of math courses the S had taken reduced the threat she perceived from the mathematical CAI task, this bias may have decreased the difference between the HA- and LA-Trait Ss' A-State level during the task.

Performance on the CAI Task: A Drive Theory Interpretation

A-Trait and dogmatism were not related to errors on the CAI task. However, A-State and math ability were related to performance in a manner which is consistent with predictions derived from Spence-Taylor Drive Theory (Spence, 1958; Taylor, 1956). According to Drive Theory, in complex learning tasks where there are many competing response tendencies, HA-State (Drive) will facilitate performance. When there are few competing response tendencies, HA-State will produce decrements in performance. It follows from Spielberger's (1966b) interpretation of Drive Theory, that on a complex mathematical task there will be fewer competing responses for Ss with high math ability (HMA) than for Ss with low math ability (LMA). Therefore, HA-State Ss who rated themselves low in math ability should have made more errors on the complex mathematical CAI task than LA-State Ss who rated themselves low in math ability. However, among those who rated themselves high in math ability, HA-State Ss should make fewer errors than LA-State Ss. This is basically what

occurred in the present study. HA-State/LMA Ss made over twice as many errors as LA-State/LMA Ss, while HA-State/HMA Ss made a fraction less errors than LA-State/HMA Ss. HMA Ss made so few errors that a "floor effect" apparently prevented HA-State from having a stronger facilitative effect for these Ss. These results are also consistent with previous studies which have demonstrated that ability and anxiety have an interactive effect on performance on learning tasks (e.g., Denny, 1963; Spielberger, 1966b; Gaudry & Spielberger, 1970). These findings suggest that in order to understand performance in complex learning tasks it is necessary to consider both anxiety and intellectual factors.

The relationship obtained between A-State and errors in the present study is also consistent with Drive Theory. There are more errrors and hence, more competing responses in Section A of the CAI task than on Sections B and C. As Drive Theory would predict, HA-State Ss tended to make more errors than LA-State Ss on Section A. On Sections B and C, both groups made about the same amount of errors. However, this trend failed to reach statistical significance since there was large variability in the number of errors. Math ability, being a determinant of performance on the task, contributed to the variability within experimental groups as each group was heterogeneous with regard to math ability.

However, there is an alternate explanation for the obtained relationship between A-State, math ability and errors. In contrast to Drive Theory, the alternate explanation posits that the making of errors resulted in A-State elevations. The difference in the two accounts is in terms of the cause-effect relationship. Perhaps the processes indicated by Drive theory and the alternate explanation were both operating in the present study. Thus, possibly errors caused A-State elevations while A-State (Drive) affected error production.

SUMMARY

This study was concerned with the effects of anxiety and dogmatism in computer assisted learning. Several hypotheses based on Rokeach's conception of dogmatism and Spielberger's Trait-State Anxiety Theory were set forth. Female Ss were selected on the basis of extreme scores on the STAI A-Trait Scale and the Dogmatism Scale. The computer assisted learning task consisted of difficult mathematical problems presented by an IBM 1500 CAI system.

The hypothesized relationship between dogmatism and A-State was not confirmed. When controlled for A-Trait, HD and LD Ss did not differ in the level of A-State displayed during the experiment. As hypothesized, HA-Trait Ss had significantly higher higher levels of A-State during the experiment than LA-Trait Ss.

Neither A-Trait nor dogmatism was related to errors on the CAI task. However, a significant interactive effect of math ability and A-State on performance was observed. HA-State resulted in more errors for low math ability Ss but had no effect on the performance of high math ability Ss. This finding was explained in terms of Drive Theory.

APPENDICES

APPENDIX A

THE STATE-TRAIT ANXIETY INVENTORY (STAI)

Self-Evaluation Questionnaire

STAI Form X-1

Name _____ Date _____

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel right now, that is, at this moment.

There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	Not at all	Somewhat	Moderately so	Very much so
1. I feel calm	1	2	3	4
2. I feel secure	1	2	3	4
3. I am tense	1	2	3	4
4. I am regretful	1	2	3	4
5. I feel at ease	1	2	3	4
6. I feel upset	1	2	3	4
7. I am presently worrying over possible misfortunes	1	2	3	4
8. I feel rested	1	2	3	4
9. I feel anxious	1	2	3	4
10. I feel comfortable	1	2	3	4
11. I feel self-confident	1	2	3	4
12. I feel nervous	1	2	3	4
13. I am jittery	1	2	3	4
14. I feel "high strung"	1	2	3	4
15. I am relaxed	1	2	3	4
16. I feel content	1	2	3	4
17. I am worried	1	2	3	4
18. I feel over-excited and rattled	1	2	3	4
19. I feel joyful	1	2	3	4
20. I feel pleasant	1	2	3	4

X-2

Name _____ Date _____

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you generally feel.

There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

	Almost never	So etimes	Often	Almost always
21. I feel pleasant	1	2	3	4
22. I tire quickly	1	2	3	4
23. I feel like crying	1	2	3	4
24. I wish I could be as happy as others seem to be	1	2	3	4
25. I am losing out on things because I can't make up my mind soon enough	1	2	3	4
26. I feel rested	1	2	3	4
27. I am "calm, cool, and collected"	1	2	3	4
28. I feel that difficulties are piling up so that I cannot overcome them	1	2	3	4
29. I worry too much over something that really doesn't matter	1	2	3	4
30. I am happy	1	2	3	4
31. I am inclined to take things hard	1	2	3	4
32. I lack self-confidence	1	2	3	4
33. I feel secure	1	2	3	4
34. I try to avoid facing a crisis or difficulty	1	2	3	4
35. I feel blue	1	2	3	4
36. I am content	1	2	3	4
37. Some unimportant thought runs through my mind and bothers me	1	2	3	4
38. I take disappointments so keenly that I can't put them out of my mind	1	2	3	4
39. I am a steady person	1	2	3	4
40. I become tense and upset when I think about my present concerns	1	2	3	4

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APPENDIX B

SHORT FORM OF THE STATE-TRAIT ANXIETY INVENTORY

SHORT FORM OF THE STATE-TRAIT ANXIETY INVENTORY

1. I am tense.
2. I feel at ease.
3. I am relaxed.
4. I feel calm.
5. I am jittery.

The subject responded to each item by rating herself on the following four-point scale: (1) Not at all; (2) Somewhat; (3) Moderately so; (4) Very much so.

APPENDIX C

ROKEACH'S DOGMATISM SCALE

Questionnaire II

The following is a study of what the general public thinks and feels about a number of important social and personal questions. The best answer to each statement below is your personal opinion. We have tried to cover many different opposing points of view: you may find yourself agreeing strongly with some of the statements, disagreeing just as strongly with others, and perhaps uncertain about others: whether you agree or disagree with any statement, you can be sure that many people feel the same as you do.

Mark each statement in the left margin according to how much you agree or disagree with it. Please mark every one. Write +1, +2, +3, or -1, -2, -3, depending on how you feel in each case.

+1:	I AGREE A LITTLE	-1:	I DISAGREE A LITTLE
+2:	I AGREE ON THE WHOLE	-2:	I DISAGREE ON THE WHOLE
+3:	I AGREE VERY MUCH	-3:	I DISAGREE VERY MUCH

____ 1. The United States and Russia have just about nothing in common.

____ 2. The highest form of government is a democracy and the highest form of democracy is a government run by those who are most intelligent.

____ 3. Even though freedom of speech for all groups is a worthwhile goal, it is unfortunately necessary to restrict the freedom of certain political groups.

____ 4. It is only natural that a person would have a much better acquaintance with ideas he believes in than with ideas he opposes.

____ 5. Man on his own is a helpless and miserable creature.

____ 6. Fundamentally, the world we live in is a pretty lonesome place.

____ 7. Most people just don't give a "damn" for others.

____ 8. I'd like it if I could find someone who would tell me how to solve my personal problems.

____ 9. It is only natural for a person to be rather fearful of the future.

____10. There is so much to be done and so little time to do it in.

____11. Once I get wound up in a heated discussion I just can't stop.

____12. In a discussion I often find it necessary to repeat myself several times to make sure I am being understood.

+1: I AGREE A LITTLE
+2: I AGREE ON THE WHOLE
+3: I AGREE VERY MUCH

-1: I DISAGREE A LITTLE
-2: I DISAGREE ON THE WHOLE
-3: I DISAGREE VERY MUCH

___13. In a heated discussion I generally become so absorbed in what I am going to say that I forget to listen to what the others are saying.

___14. It is better to be a dead hero than to be a live coward.

___15. While I don't like to admit this even to myself, my secret ambition is to become a great man, like Einstein, or Beethoven, or Shakespeare.

___16. The main thing in life is for a person to want to do something important.

___17. If given the chance I would do something of great benefit to the world.

___18. In the history of mankind there have probably been just a handful of really great thinkers.

___19. There are a number of people I have come to hate because of the things they stand for.

___20. A man who does not believe in some great cause has not really lived.

___21. It is only when a person devotes himself to an ideal or cause that life becomes meaningful.

___22. Of all the different philosophies which exist in this world there is probably only one which is correct.

___23. A person who gets enthusiastic about too many causes is likely to be a pretty "wishy-washy" sort of person.

___24. To compromise with our political opponents is dangerous because it usually leads to the betrayal of our own side.

___25. When it comes to differences of opinion in religion we must be careful not to compromise with those who believe differently from the way we do.

___26. In times like these, a person must be pretty selfish if he considers primarily his own happiness.

___27. The worst crime a person could commit is to attack publicly the people who believe in the same thing he does.

___28. In times like these it is often necessary to be more on guard against ideas put out by people or groups in one's own camp than by those in the opposing camp.

+1: I AGREE A LITTLE
+2: I AGREE ON THE WHOLE
+3: I AGREE VERY MUCH

-1: I DISAGREE A LITTLE
-2: I DISAGREE ON THE WHOLE
-3: I DISAGREE VERY MUCH

___29. A group which tolerates too much differences of opinion among its own members cannot exist for long.

___30. There are two kinds of people in this world: those who are for the truth and those who are against the truth.

___31. My blood boils whenever a person stubbornly refuses to admit he's wrong.

___32. A person who thinks primarily of his own happiness is beneath contempt.

___33. Most of the ideas which get printed nowadays aren't worth the paper they are printed on.

___34. In this complicated world of ours the only way we can know what's going on is to rely on leaders or experts who can be trusted.

___35. It is often desirable to reserve judgment about what's going on until one has had a chance to hear the opinions of those one respects.

___36. In the long run the best way to live is to pick friends and associates whose tastes and beliefs are the same as one's own.

___37. The present is all too often full of unhappiness. It is only the future that counts.

___38. If a man is to accomplish his mission in life it is sometimes necessary to gamble "all or nothing at all."

___39. Unfortunately, a good many people with whom I have discussed important social and moral problems don't really understand what's going on.

___40. Most people just don't know what's good for them.

APPENDIX D

INTRODUCTORY BOOKLET

Welcome to the Computer-Assisted Instruction Center. We have developed a program that will enable you to master some fundamentals of the field properties of numbers and provide a review of compound fractions. It has been found that success in this program does not require mathematical or quantitative ability--it requires, instead, the ability to make the same kinds of abstractions and generalizations that you are expected to make in many college courses. We are interested in your reactions to this program, and we will ask you to fill out an inventory concerning your feelings at appropriate places in this program.

INTRODUCTION

To be able to communicate with the computer there are a few basic facts you need to know. You have two media at your terminal by which to enter answers to be processed by the computer: the keyboard and the light pen.

The light pen is located on the lower right side of the screen. When you use the light pen:

1. Be sure of the area you wish to touch with your light pen.
2. Press the area firmly and steadily with the light pen.
3. Withdraw the pen without dragging it across the screen.

NOTE: A "P" will appear in the lower right-hand corner of the screen when a light pen response is required. This "P" must appear before you select your answer.

The other response device is the keyboard. The keyboard has 44 keys, allowing 88 characters (44 upper-case and 44 lower-case). In addition, there are 8 function keys, such as c/r, backspace, shift, etc., and an alternate coding key. The alternate coding key, in combination with the function or with some of the regular keys, can provide an additional 38 characters.

NOTE: There are several keys that may seem similar to other keys. For example, the numeral "0" resembles the letter "O" and the numeral "1" (one) resembles the lower case "l" (el). Be careful to use the correct character in your response. Failure to do this may result in the computer analyzing your response incorrectly.

Four of the combinations of the function key and the alternate coding key will be of particular help to you. These combinations will allow you to:

1. Signal the computer that you have typed an answer and it is ready to be processed--this is the "enter" command.

2. Cancel an answer that you have typed.

3. Erase part or all of an answer you have typed.

4. Use subscripts and superscripts in your responses.

Just as with the light pen responses, in keyboard responses a "K" will appear in the lower right corner of the screen.

Now, let's discuss the features of each of the preceding combinations:

Enter command after typing in your answer.

1. Hold down the alternate coding key and, while holding it down, press the space bar.

2. Release both the alternate coding key and the space bar.

The enter command is used only when making a keyboard response.

Cancelling an answer.

If you enter an answer and make a mistake or change your mind (before using the enter command), you may cancel your response by:

1. Pressing the alternate coding key and, while pressing it, press the dash key (-).

2. Release the keys and perform the enter command.

You may then enter another response. (Cancelling may be done only before you have entered the enter command.)

Erase a letter or total answer.

If you enter one or more incorrect characters and wish to correct them:

1. Press the alternate coding key and, while holding it, press the backspace key. Press the backspace key once for each character you want to erase.

2. Release the keys, type the correct character or characters.

3. Perform the enter command.

When you are given a choice of answers, the correct answer is always present.

Remember to press the altn coding key and space bar simultaneously after completing each response. Unless this is done, the computer will not type, and you will be unable to complete the next item.

If the computer should stop for an excessive amount of time, press altn coding and the space bar simultaneously. If nothing happens, or if you have any difficulty, call the proctor.

When the "K" or "P" comes on, you do not have to respond immediately unless you wish to. The computer is patient.

If you read the screen quickly and do not wish for the computer to present new material at its own pace, press the light pen against the screen.

When you have finished these instructions, please call the proctor.

APPENDIX E

INTRODUCTION TO COMPLEX NUMBERS

This booklet was given to each subject immediately after the pretask A-State measure.

INTRODUCTION TO COMPLEX NUMBERS

NOTATION: Because of limitations of the typewriter keyboard, it is sometimes necessary to use a certain convention for multiplication and exponentiation. The "*" is often used. So when you see expressions such as "a*b" and "a**2" you should recognize them as "a times b" and "a squared" respectively. However, many times for multiplication "a times b" will simply be "ab".

Definition: A complex number Z is an ordered pair of real numbers (a,b). Likewise for all real numbers, a and b, each ordered pair (a,b) is a complex number Z.

Examples of complex numbers are (6,5), (1/2,-1) and (4,3**1/2).

Definition of Equality:

Two complex numbers are equal if and only if they have the same first component and the same second component. That is, if Z1=(a,b) and Z2=(c,d), Z1=Z2 if and only if a=c and b=d.

(-3,5)=(-6/2,4+1) since -3=-6/2 and 5=4+1 (4,7) does not equal (7,4) since 4 does not equal 7

You have previously learned that the set of real numbers, R, together with the operations of addition and multiplication forms a field.

If we denote the set of complex numbers by C and define some type of addition and multiplication on C, we can then determine if this new system satisfies the field Postulates.

Before we define addition and multiplication of complex numbers, we'll have a brief review of the properties that characterize a field, and we will see why R under addition and multiplication satisfies each property of a field.

1. Closure for addition: For every a, b in R, a+b is also in R

2. Commutativity with respect to addition: For every a, b in R, a+b=b+a

3. Associativity with respect to addition: For every a, b and c in R, (a+b)+c=a+(b+c)

4. Additive identity: 0 is the additive identity for R since for every a in R a+0=0+a=a

5. Additive inverse: For every a in R, -a is the additive inverse since a+(-a)=-a+a=0

6. Closure under multiplication: For every a, b in R ab is also in R

7. Commutativity with respect to multiplication: For every a,b in R, ab=ba

8. Associativity with respect to multiplication: For every a, b and c in R, (ab)c=a(bc)

9. Multiplicative identity: 1 is the multiplicative identity for R since for every a in R, a*1=1*a=a

10. Multiplicative inverse: 1/a is the multiplicative inverse for every a in R except 0 since 1/a*a=a*1/a=1

11. Multiplication is distributive over addition: For every a, b and c in R, a(b+c)=ab+ac

This completes the review of the field properties for real numbers. Our next task is to verify that C, the set of complex numbers under the operations of addition and multiplication, is a field.

Before checking the field properties for C, it is necessary to make certain definitions.

Definition of addition in C: For all complex numbers, Z1 and Z2, and all real numbers, a, b, c, and d, if Z1=(a,b) and Z2=(c,d), then Z1+Z2=(a+c,b+d).

Example: (3,4)+(2,7)=(5,11).

Definition of multiplication in C: For all complex numbers, Z1 and Z2, and for all real numbers a, b, c, and d, if Z1=(a,b) and Z2=(c,d), then Z1Z2=(ac-bd,ad+bc).

For example, (3,7)(5,2)=(15-14,6+35)=(1,41).

We will now present 11 proofs to establish that C under addition and multiplication is a field.

You are to supply the abbreviation for the reason that justifies each step in each of the 11 proofs.

These abbreviations are on the sheet of paper called ABBREVIATIONS.

Remember that the correct answer has to be one of the reasons.

So keep trying them if you are using a wrong abbreviation. GOOD LUCK.

ABBREVIATIONS

The following abbreviations should be used for the reasons required for the proofs of the field properties for complex numbers:

Abbreviation	
cra	Closure in R under addition
crm	Closure in R under multiplication
cca	Closure in C under addition
ccm	Closure in C under multiplication
ca	Commutativity with respect to Addition in R
cm	Commutativity with respect to Multiplication in R
aa	Associativity with respect to Addition in R
am	Associativity with respect to Multiplication in R
rt	Rearrangement of Terms in R
dma	Distributivity of Multiplication over Addition in R
dc	Definition of a Complex Number-An Ordered Pair of Real Numbers
da	Definition of Addition in C
ds	Definition of Subtraction in C
dm	Definition of Multiplication in C
dd	Definition of Division in C
de	Definition of Equality in C
s	Substitution of terms
ar	Addition in R
sr	Subtraction in R
mr	Multiplication in R
dr	Division in R
tr	Transitive property for real numbers
c	Cancellation in R
tt	Transposition of Terms

APPENDIX F

POSTTASK QUESTIONNAIRE

Appendix F

POSTTASK QUESTIONNAIRE (PTQ)

After each S completed the CAI task, she was administered a questionnaire in order to obtain additional information for this study. This questionnaire appears on the following page. The questionnaire was designed to sample several areas of affect and mathematical ability. First, the amount of concern that the S had about the task (Questions 1 and 3) was determined. Second, the need for peer evaluation (Question 2) was ascertained. Third, the egree of enjoyment (Questions 4 and 5) and confidence (Questions 6 and 7) during the CAI task was evaluated. Fourth, the S's mathematical ability (Questions 8 and 9) was investigated. In addition, information concerning prior knowledge about the experiment was collected and space was provided for additional comments.

The means and standard deviations for the questionnaire data are reported in Table 11. The data for each question, unless indicated otherwise, were evaluated by a two way ANOVA in which A-Trait and dogmatism are the independent variables.

The absence of statistical significance in ANOVAs performed on Questions 1 and 3 indicate that the amount of concern the Ss had about their performance on the

Name_____ Age_____ Social Sec. No._____

The following questions are designed to allow us to make a more realistic analysis of this study and to improve future ones. PLEASE CIRCLE THE RESPONSE THAT MOST NEARLY REPRESENTS YOUR REACTION TO EACH OF THE STATEMENTS BELOW:

1. I was not concerned when I missed a question because no one was watching me anyway.

1	2	3	4	5
Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

2. I felt uncertain as to my performance in the course relative to the performance of others.

1	2	3	4	5
Never	Occasionally	Some of the time	Most of the time	All of the time

3. How much concern about your performance did you have?

1	2	3	4	5
Very little concern				Very much concern

4. How much did you enjoy working on the <u>initial part</u> of the learning task?

1	2	3	4	5
Not at all				Very much

5. How much did you enjoy working on the <u>final part</u> of the learning task?

1	2	3	4	5
Not at all				Very much

6. How confident were you during the <u>initial part</u> of the learning task?

1	2	3	4	5
Not confident				Very confident

7. How confident were you during the <u>final part</u> of the learning task?

1	2	3	4	5
Not confident				Very confident

SS

8. Relative to other college students, rate your mathematical ability in one of the following terms:

1	2	3
Below average	Average	Above average

9. Indicate the number of mathematics courses that you have taken, are now taking, or have exempted on the college level.

_____have taken

_____now taking

_____exempted

10. Had you heard anything about the experiment prior to participating in it?

11. Have you ever participated in computer assisted learning before? (If yes, please describe the circumstances.)

Additional comments:

TABLE 11.--Means of the Posttask Questionnaire data for the four experimental groups

Groups	Questions 1	2	3	4	5	6	7	8	9
HA-Trait/HD									
Mean	2.6	2.4	3.3	2.3	3.3	2.5	2.9	2.1	3.4
SD	1.4	1.1	1.3	1.2	1.7	1.2	1.5	.7	4.3
HA-Trait/LD									
Mean	2.2	2.5	3,0	2.8	3.6	2.5	3.3	2.1	4.0
SD	1.1	1.1	1.1	1.6	1.4	1.5	1.3	.8	4.4
LA-Trait/HD									
Mean	2.3	2.4	3.6	3.5	3.1	2.6	3.2	1.8	2.1
SD	1.1	.7	.8	1.1	1.3	.9	1.4	.8	1.8
LA-Trait/LD									
Mean	2.9	2.4	3.1	3.2	3.1	3.3	2.9	1.7	1.7
SD	1.5	1.1	1.4	1.4	1.5	1.4	1.5	.7	1.2
All groups									
Mean	2.5	2.4	3.3	3.0	3.3	2.7	3.1	1.9	2.8
SD	1.3	1.0	1.2	1.4	1.4	1.3	1.4	.8	3.3

(N=15 for each group)

task was unrelated to A-Trait or dogmatism. The results of the ANOVAs are presented in Table 12.

Dogmatism and A-Trait were not related to the need for peer evaluation during the task as is shown in Table 13 by the absence of any statistically significant effects in the ANOVA for Question 2.

TABLE 12.--Summary of the analyses of variance for concern about performance for the four experimental groups

Source	df	A. Question 1 MS	A. Question 1 F	B. Question 3 MS	B. Question 3 F
A-Trait (A)	1	.4	<1	.8	<1
Dogmatism (D)	1	.2	<1	2.0	1.43
A x D	1	3.8	2.38	.2	<1
Error	56	1.6		1.4	

*p<.05
**p<.01

TABLE 13.--Summary of analysis of variance for peer evaluation for the four experimental groups

Source	Question 2 df	MS	F
A-Trait (A)	1	.02	<1
Dogmatism (D)	1	.02	<1
A x D	1	.02	<1
Error	56	1.01	

*p<.05
**p<.01

Since Question 4 was concerned with enjoyment of the initial part of the learning task and Question 5 with enjoyment in the final part of the learning task, these data were evaluated by a three way ANOVA in which A-Trait, dogmatism and periods were the independent variables with repeated measures on the last factor. A significant interaction between A-Trait and periods can be observed in Table 14. LA-Trait Ss enjoyed the initial part of the task more than the HA-Trait Ss. However, for the final part of the learning task, HA-Trait Ss expressed somewhat more enjoyment than LA-Trait Ss.

Confidence during the initial and final parts of the task was also evaluated by a three way ANOVA in which A-Trait, dogmatism, and periods are independent variables, with repeated measures on the last factor. The lack of statistically significant effects reported in Table 15 reveals that confidence during the task was unrelated to A-Trait or dogmatism.

Although HA-Trait Ss tended to rate themselves higher in math ability than LA-Trait Ss, the absence of a statistically significant effect of A-Trait in Table 16a indicates that this difference was not reliable. However, as indicated by the significant A-Trait effect in Table 16b, HA-Trait Ss had taken more math courses than LA-Trait Ss. Dogmatism was not related to either measure of math ability.

TABLE 14.--Summary of the analysis of variance for the enjoyment of the initial and final portions of the CAI task for the four experimental groups (Questions 4 and 5)

Source	df	MS	F
A-Trait (A)	1	1.6	<1
Dogmatism (D)	1	.5	<1
A x D	1	1.6	<1
error (b)	56	2.5	
Periods (P)	1	3.3	2.36
A x P	1	9.6	6.86**
D x P	1	0.0	<1
A x D x P	1	.3	<1
error (w)		1.4	

*p<.05
**p<.01

TABLE 15.--Summary of the analysis of variance for confidence during the initial and final portions of the CAI task for the four experimental groups (Questions 6 and 7)

Source	df	MS	F
A-Trait (A)	1	.8	<1
Dogmatism (D)	1	.8	<1
A x D	1	0.0	<1
error (b)	56	1.6	
Periods (P)	1	3.3	1.65
A x P	1	1.6	<1
D x P	1	.8	<1
A x D x P	1	3.3	1.65
error (w)	56	2.0	

*p<.05
**p<.01

TABLE 16.--Summary of the analysis of variance for math ability for the four experimental groups

Source	df	MS	F	MS	F
A-Trait (A)	1	2.0	3.33	50.4	4.80*
Dogmatism (D)	1	.0	<1	.2	<1
A x D	1	.2	<1	3.8	<1
Error	56	.6		10.5	

*p <.05
**p <.01

APPENDIX G

CORRELATIONAL ANALYSES

APPENDIX G

CORRELATIONAL ANALYSES

The correlation matrix which is presented in Table 18 was computed by intercorrelating all the variables in order to further examine the relationship between them.

The negative correlations between rated math ability and errors was noted in the Results section. Several other findings were briefly noted. It can be seen from the correlation matrix that dogmatism did not correlate significantly with any variables during the CAI task. A-Trait was related to all A-State measures except A-State during Section C of the task. While A-Trait was unrelated to errors, the significant correlations between errors and A-State on Sections A, B and C indicated that Ss who displayed higher levels of A-State made more errors.

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TABLE 17.--Correlation matrix between all variables

Variable	No.	1	2	3	4	5	6	7
Sec. A Errors	1.	1.00						
Sec. B Errors	2	63**	1.00					
Sec. C Errors	3	46**	64**	1.00				
Pre. A-State	4	-14	-06	-17	1.00			
Sec. A A-State	5	29*	15	08	10	1.00		
Sec. B A-State	6	53**	37**	21	19	72**	1.00	
Sec. C A-State	7	36**	15	25*	17	60**	74	1.00
A-Trait	8	05	07	-17	28*	30*	36**	18
Dogmatism	9	11	09	-05	04	05	20	20
PTQ Question 1	10	-02	16	16	15	-08	-10	-07
PTQ Question 2	11	-06	-06	-12	-09	20	03	-09
PTQ Question 3	12	-16	-26*	-26*	02	06	03	-03
PTQ Question 4	13	-24	-01	16	-22	-28*	-39**	-30*
PTQ Question 5	14	-55**	-49**	-52**	16	-29*	-36**	-37**
PTQ Question 6	15	-09	09	17	-24	-16	-18	01
PTQ Question 7	16	-53**	-47**	-49**	08	-33*	-38**	-39**
Rated Math Ability	17	-40**	-50**	-42**	18	-19	-17	-15
No. of Math Courses	18	-28*	-23	-29*	21	-00	02	-02

*p<.05 (N=60)
**p<.01

TABLE 17.--Continued

8	9	10	11	12	13	14	15	16	17	18
1.00										
11	1.00									
-07	01	1.00								
10	02	-18	1.00							
-05	18	-44**	22	1.00						
-42**	-01	-02	-08	-08	1.00					
03	-03	05	02	16	25*	1.00				
-20	-01	02	-11	-05	44**	-10	1.00			
-03	-03	-05	-15	22	05	78**	-14	1.00		
21	00	-17	-02	31*	-28*	50**	-23	60**	1.00	
28*	-06	-23	09	29*	-29*	17*	-19	33*	56**	1.00

APPENDIX H

CORRELATIONAL ANALYSIS OF THE RELATIONSHIP BETWEEN DOGMATISM AND A-TRAIT

APPENDIX H

CORRELATIONAL ANALYSIS OF THE RELATIONSHIP BETWEEN DOGMATISM AND A-TRAIT

A correlation of .26 (p .01) was obtained between scores on the Dogmatism and STAI A-Trait Scales which were administered to 198 female Ss during the group testing. A number of other investigators have also reported positive and significant correlations between dogmatism and anxiety (Rokeach & Kemp, 1960; Fillenbaum & Jackman, 1961; Norman, 1966; Pyron, 1966; Rebhun, 1966). The significant positive correlation indicates that the higher an individual scores in dogmatism, the higher her level of A-Trait.

In order to further investigate the nature of the relationship between dogmatism and A-Trait, each S's A-Trait score was correlated with her scores on each of the 40 items of the Dogmatism Scale. For each item on the Dogmatism Scale, the S responded on a 6 point format ranging from +3 (agree very much) to -3 (disagree very much). The correlations between A-Trait and the 40 items of the Dogmatism Scale are presented in Table 18.

There were no significant negative correlations, but significant positive correlations were obtained between A-Trait scores and 11 items on the Dogmatism Scale. The context of the items for which significant correlations were obtained suggest that individuals who are high in A-Trait

TABLE 18.--Correlations between A-Trait and items from the Dogmatism Scale

Items from Dogmatism Scale	A-Trait
1. U.S and Russia have nothing in common	.03
2. Best government is democracy run by most intelligent.	.01
3. Belief in free speech, but not for all.	.08
4. Better knowledge of beliefs than disbeliefs	-.03
5. Man on his own is helpless and miserable.	.01
6. World we live in a lonesome place.	.29**
7. Most people don't give a damn for others.	.25**
8. I want to find someone to solve my problems.	.36**
9. It's natural to fear future.	.29**
10. So much to do, so little time to do it in.	.09
11. Once I get wound up, I can't stop.	.03
12. I repeat myself to make sure I'm understood.	.21**
13. I don't listen.	.23**
14. Better be dead hero than live coward.	.06
15. Secret ambition is to become a great man.	.17*
16. Main thing in life is to do something important.	.10
17. If given chance, I'd benefit world.	-.07
18. There are just a handful of great thinkers.	.04
19. I hate some people because of what they stand for	.20**
20. A man without a cause hasn't lived.	-.03
21. Life meaningful when there is devotion to cause.	.06

TABLE 18.--Continued

Items from Dogmatism Scale	A-Trait
22. There is only one correct philosophy.	-.06
23. Person believing in too many causes is wishy-washy.	-.06
24. To compromise is to betray own side.	.11
25. In religion, we should not compromise.	-.01
26. To consider only one's own happiness is selfish.	-.02
27. Worse crome is to attack those of similar beliefs.	-.11
28. Guard against subversion from within.	-.02
29. Groups tolerating diverse opinions can't exist.	.03
30. Two kinds of people; those for, those against truth.	-.08
31. My blood boils when others won't admit they're wrong.	.26**
32. One who thinks of own happiness beneath contempt.	.05
33. Most printed ideas aren't worth paper printed on.	.07
34. To know what's going on, rely on leaders.	.03
35. Reserve judgment until you hear leaders' opinions.	.22**
36. Pick friends who believe as you do.	-.01
37. Present unhappy. Future is what counts.	.21**
38. To accomplish mission, gamble all or nothing.	-.01
39. Most people don't understand what's going on.	.08
40. Most people don't know what's good for them.	.13

*p<.05 **p<.01

tend to be lonely, alienated, unhappy, hostile and fearful of the future. On the other hand, A-Trait tends not to correlate significantly with items that appear to tap isolation and differentiation of belief-disbelief systems, intolerance, and aspects of a future time perspective. According to Rokeach, these are integral components of the dogmatic person. An implication from these findings is that the positive correlations between dogmatism and A-Trait is to a large extent a function of the correlation between A-Trait and certain Dogmatism items which are also tapping aspects of trait anxiety.

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